No. A9—1923

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CANADIAN ENGINEERING STANDARDS ASSOCIATION

(INCORPORATED 1919)

STANDARD SPECIFICATIONS

FOR

REINFORCING MATERIALS FOR CONCRETE

VIZ:

BILLET-STEEL REINFORCING BARS

RAIL-STEEL REINFORCING BARS

AND

STEEL WIRE FOR CONCRETE REINFORCEMENT.

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OTTAWA, MAY, 1923

PRICE 25 CENTS

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PREFACE

THE desirability of adopting definite specifications for reinforcing materials for concrete as employed in Canada was pointed out by one of the largest steel manufacturers in December, 1920, and the Main Committee approved of the formation of a Panel for this purpose in April, 1921, enquiry having shown that leading designers, manufacturers and users were anxious to discuss the subject.

In order to co-ordinate the Panel's work with that of the C.E.S.A. Sub-Committee on Concrete and Reinforced Concrete, the Sectional Committee on Cement and Concrete was asked to nominate certain members, others being nominated by the Sectional Committee on Steel, a Joint Panel thus being formed.

The views of the various interests, obtained by correspondence, indicated that the general lines of the corresponding specifications of the American Society for Testing Materials should be followed, on account of the similarity between manufacturing and construction methods and conditions obtaining in Canada and in the United States. Draft specifications were accordingly prepared, and were considered and amended at the first meeting of the Panel held in June 1922. The specifications in their amended form were further considered and modified, and ultimately approved by the Panel by letter ballot in February, 1923. They were approved by the Sectional Committees on Steel and on Concrete and Reinforced Concrete in March, and publication was authorized by the Main Committee at its ninth meeting on April 16th, 1923.

May 1923.

C.E.S.A. PUBLICATIONS

No. A1 —1922 Standard Specification for Steel Railway Bridges.

A1a—1922 Material Specifications, Steel Railway Bridges (*Separate Reprint*).

C2 —1920 Standard Requirements for Distribution Type Transformers.

C3 —1921 Standard Specification for Galvanized Telegraph and Telephone Wire.

B4 —1921 Standard Specification for Wire Rope for Mining, Dredging and Steam Shovel Purposes.

A5 —1922 Standard Specification for Portland Cement.

A6 —1922 Standard Specification for Steel Highway Bridges.

D7 —1922 Standard Specification for Flexible Steel Wire Rope and Flexible Strand for Aircraft Purposes.

G8 —1923 Standard General Specification for Commercial Bar Steels.

A9 —1923 Standard Specifications for Reinforcing Materials for Concrete.

The above are on sale at 25 cents per copy, and may be obtained from—

The Secretary,
Canadian Engineering Standards Association,
638-9 Jackson Building,
Ottawa, Ont.

Note:—In order to keep abreast of progress in the Industries concerned, the C. E. S. A. Publications are subject to periodical review.

Suggestions for improvement, addressed to the Secretary, will be welcomed at all times. They will be recorded, and in due course brought to the notice of the Committees charged with the revision of the Publications to which they refer.

No. A9—1923 (a)

NOTE:—*The Association desires to call attention to the fact that this Specification is intended to include the technical provisions necessary for the supply of the article herein referred to, but does not purport to comprise all the necessary provisions of a Contract.*

C. E. S. A.

STANDARD SPECIFICATION FOR BILLET STEEL REINFORCING BARS

The provisions of this Specification are in substantial agreement with those of Specification A15-14 of the American Society for Testing Materials.

MATERIAL

Material Covered

1. This Specification covers three classes of billet-steel reinforcing bars, namely: plain, deformed, and cold-twisted.

2. Bars are of three grades, namely: structural-steel, intermediate and hard.

Basis of Purchase

3. The structural-steel grade shall be used unless otherwise specified.

MANUFACTURE

Processes

4. The steel shall be made by either the Bessemer or open-hearth process.

5. The bars shall be rolled direct from new billets.

Cold-twisted Bars

6. Cold-twisted bars shall be twisted cold with one complete twist in a length not over 12 times the thickness of the bar.

CHEMICAL PROPERTIES AND TESTS

Chemical Composition

7. The steel shall conform to the following requirements as to chemical composition:

Phosphorus	Bessemer	not over	0.10	per	cent.
	Open-hearth	" "	0.05	"	"

Ladle Analyses

8. An analysis of each melt of steel shall be made by the Manufacturer to determine the percentages of carbon, manganese, phosphorus and sulphur. This analysis shall be made from a test ingot taken during the pouring of the melt. The chemical composition thus determined shall be reported to the Purchaser or his representative, and shall conform to the requirements specified above.

Check Analyses

9. Check analyses may be made by the Purchaser from finished bars representing each melt of open-hearth steel, and each melt, or lot of ten tons, of Bessemer steel. The phosphorus content thus determined shall not exceed that specified above under "Chemical Composition" by more than 25 per cent.

PHYSICAL PROPERTIES AND TESTS

Tension Tests

10. The bars shall conform to the following requirements as to tensile properties, except as modified hereinafter:

TENSILE PROPERTIES

Properties Considered	Plain Bars			Deformed Bars			Cold-twisted Bars
	Structural Steel Grade.	Intermediate Grade.	Hard Grade.	Structural Steel Grade.	Intermediate Grade.	Hard Grade.	
Tensile strength, lb. per sq. inch	55 000 to 70 000	70 000 to 85 000	80 000 min.	55 000 to 70 000	70 000 to 85 000	80 000 min.	Recorded only
Yield point, lb. per sq. inch	33 000	40 000	50 000	33 000	40 000	50 000	55 000
Elongation in 8 inches, min. per cent.	1 400 000 / Tens. str.	1 300 000 / Tens. Str.	1 200 000 / Tens. str.	1 250 000 / Tens. str.	1 125 000 / Tens. str.	1 000 000 / Tens. str.	5

Yield Point

11. The yield point shall be determined by the drop of the beam of the testing machine.

Modifications in Elongation

12. For plain and deformed bars over 3/4 inch in thickness or diameter, a deduction of 0.25 from the percentages of elongation specified above under "Tension Tests" shall be made for each increase of 1/32 inch in thickness or diameter above 3/4 inch.

13. For plain and deformed bars under 7/16 inch in thickness or diameter, a deduction of 0.50 from the percentages of elongation specified above under "Tension Tests" shall be made for each decrease of 1/32 inch in thickness or diameter below 7/16 inch.

Bend Tests

14. The test specimens shall bend cold around a pin without cracking on the outside of the bent portion, as follows:

Bend-Test Requirements

Thickness or Diameter of Bar.	Plain Bars			Deformed Bars			
	Structural Steel Grade.	Intermediate Grade.	Hard Grade.	Structural Steel Grade.	Intermediate Grade.	Hard Grade.	Cold Twisted Bars
Under ¾ inch	180 deg. d=t	180 deg. d=2t	180 deg. d=3t.	180 deg. d=t	180 deg. d=3t	180 deg. d=4t	180 deg. d=2t
¾ inch or over.....	180 deg. d=t	90 deg. d=2t	90 deg. d=3t	180 deg. d=2t	90 deg. d=3t	90 deg. d=4t	180 deg. d=3t

NOTE: d=diameter of pin about which the specimen is bent;
t=thickness or diameter of the specimen.

Test Specimens

15. Tension and bend test specimens for plain and deformed bars shall be taken from the finished bars, and shall be of the full thickness or diameter of bars as rolled; except that the specimens for deformed bars may be machined for a length of at least 9 inches if deemed necessary by the Manufacturer to obtain uniform cross-section.

16. Tension and bend test specimens for cold-twisted bars shall be taken from the finished bars without further treatment, unless otherwise specified by the Purchaser.

Number of Tests

17. One tension and one bend test shall be made from each melt of open-hearth steel, and from each melt, or lot of ten tons, of Bessemer steel; except that if material rolled from one melt differs 3/8 inch or more in thickness or diameter, one tension and one bend test shall be made from both the thickest and the thinnest material rolled.

18. If any test specimen shows defective machining or develops flaws, it may be discarded and another specimen substituted.

Re-tests

19. If the percentage of elongation of any tension test specimen is less than that specified above under "Tension Tests" and any part of the fracture is outside the middle third of the gauge length, as indicated by scribe scratches marked on the specimen before testing, a retest shall be allowed.

Permissible Variations in Weight

Permissible Variations

20. The weight of any lot of bars shall not vary more than 5 per cent. from the computed weight of that lot, based on an assumed weight of 0.2833 lb. per cubic inch.

FINISH

Finish

21. The finished bars shall be free from injurious defects and shall have a workmanlike finish.

INSPECTION AND REJECTION

Inspection

22. The Inspector representing the Purchaser shall have free entry, at all times while work on the contract of the Purchaser is being performed, to all parts of the Manufacturer's works which concern the manufacture of the bars ordered.

23. The Manufacturer shall afford the Inspector, free of cost, all reasonable facilities to satisfy him that the bars are being furnished in accordance with this Specification.

24. All tests (except check analyses) and inspection shall be made at the place of manufacture prior to shipment, unless otherwise specified, and shall be so conducted as not to interfere unnecessarily with the operation of the works.

Rejection

25. Unless otherwise specified, any rejection based on results of check analyses shall be reported within five working days from the receipt of samples.

26. Bars which show injurious defects subsequent to their acceptance at the Manufacturer's works will be rejected, and the Manufacturer shall be notified.

Rehearing

27. Samples on which check analyses have been made which represent rejected bars shall be preserved for two weeks from the date of the test report. In case of dissatisfaction with the results of the check analyses, the Manufacturer may make claim for a rehearing within that time.

NOTE:—*The Association desires to call attention to the fact that this Specification is intended to include the technical provisions necessary for the supply of the article herein referred to, but does not purport to comprise all the necessary provisions of a Contract.*

C. E. S. A.

STANDARD SPECIFICATION FOR RAIL-STEEL REINFORCING BARS

The provisions of this Specification are in substantial agreement with those of Specification A16-14 of the American Society for Testing Materials.

MATERIAL

Material Covered

1. This Specification covers three classes of rail-steel reinforcing bars, namely: plain, deformed and hot-twisted.

MANUFACTURE

Process

2. The bars shall be rolled from standard section Tee rails.

Hot-twisted Bars

3. Hot-twisted bars shall have one complete twist in a length not over 12 times the thickness of the bar.

PHYSICAL PROPERTIES AND TESTS

Tension Tests

4. The bars shall conform to the following minimum requirements as to tensile properties except as modified hereinafter:

Properties Considered	Plain Bars	Deformed and Hot-twisted Bars
Tensile strength, lb. per sq. inch	80 000	80 000
Yield Point, lb. per sq. inch	50 000	50 000
Elongation in 8 inches, per cent	$\frac{1\ 200\ 000}{\text{Tens. str.}}$	$\frac{1\ 000\ 000}{\text{Tens. str.}}$

Yield Point

5. The yield point shall be determined by the drop of the beam of the testing machine.

Modifications in Elongation

6. For bars over 3/4 inch in thickness or diameter, a deduction of 0.25 from the percentages of elongation specified above under "Tension Tests," shall be made for each increase of 1/32 inch in thickness or diameter above 3/4 inch.

7. For bars under 7/16 inch in thickness or diameter, a deduction of 0.5 from the percentages of elongation specified above under "Tension Tests," shall be made for each decrease of 1/32 inch in thickness or diameter below 7/16 inch.

Bend Tests

8. The test specimens shall bend cold around a pin without cracking on the outside of the bent portion, as follows:

Thickness or Diameter of Bar	Plain Bars	Deformed and Hot-twisted Bars
Under ¾ inch	180 deg. d = 3t	180 deg. d = 4t
¾ inch or over	90 deg. d = 3t	90 deg. d = 4t

NOTE: d = diameter of pin about which the specimen is bent; t = thickness or diameter of the specimen.

Test Specimens

9. Tension and bend test specimens for plain and deformed bars shall be taken from the finished bars, and shall be of the full thickness or diameter of bars as rolled; except that the specimens for deformed bars may be machined for a length of at least 9 inches if deemed necessary by the Manufacturer to obtain uniform cross-section.

10. Tension and bend test specimens for hot-twisted bars shall be taken from the finished bars without further treatment.

Number of Tests

11. One tension and one bend test shall be made from each lot of ten tons or less of each size of bar rolled from rails varying not more than 10 lb. per yard in nominal weight.

12. If any test specimen shows defective machining or develops flaws, it may be discarded and another specimen substituted.

Re-tests

13. If the percentage of elongation of any tension test specimen is less than that specified above under "Tension Tests" and any part of the fracture is outside the middle third of the gauge length, as indicated by scribe scratches marked on the specimen before testing, a re-test shall be allowed.

PERMISSIBLE VARIATIONS IN WEIGHT

Permissible Variations

14. The weight of any lot of bars shall not vary more than 5 per cent. from the computed weight of that lot based on an assumed weight of 0.2833 lb. per cubic inch.

FINISH

Finish

15. The finished bars shall be free from injurious defects and shall have a workmanlike finish.

INSPECTION AND REJECTION

Inspection

16. The Inspector representing the Purchaser shall have free entry, at all times while work on the contract of the Purchaser is being performed, to all parts of the Manufacturer's works which concern the Manufacture of the bars ordered.

17. The Manufacturer shall afford the Inspector, free of cost, all reasonable facilities to satisfy him that the bars are being furnished in accordance with this Specification.

18. All tests and inspection shall be made at the place of manufacture prior to shipment, unless otherwise specified, and shall be so conducted as not to interfere unnecessarily with the operation of the works.

Rejection

19. Bars which show injurious defects subsequent to their acceptance at the Manufacturer's works will be rejected, and the Manufacturer shall be notified.

NOTE:—*The Association desires to call attention to the fact that this Specification is intended to include the technical provisions necessary for the supply of the article herein referred to, but does not purport to comprise all the necessary provisions of a Contract.*

C. E. S. A.

STANDARD SPECIFICATION FOR COLD-DRAWN STEEL WIRE FOR CONCRETE REINFORCEMENT

The provisions of this Specification are in substantial agreement with those of Specification A82-21 T of the American Society for Testing Materials.

MATERIAL

Material Covered

1. This Specification covers cold-drawn steel wire to be used as such, or in fabricated form, for the reinforcement of concrete, in diameters not less than 0·080 inch nor greater than 0·500 inch.

Basis of Purchase

2. When wire is ordered by gauge number the following relation between number and diameter, in inches, shall apply unless otherwise specified.

Gauge Number	Equivalent Diameter, Inch	Gauge Number	Equivalent Diameter, Inch
0000000....	0.4900	5.....	0.2070
000000....	0.4615	6.....	0.1920
00000....	0.4305	7.....	0.1770
0000....	0.3938	8.....	0.1620
000....	0.3625	9.....	0.1483
00....	0.3310	10.....	0.1350
0....	0.3065	11.....	0.1205
1....	0.2830	12.....	0.1055
2....	0.2625	13.....	0.0915
3....	0.2437	14.....	0.0800
4....	0.2253		

MANUFACTURE

Process

3. The steel shall be made by either or both the following processes: Bessemer or open-hearth.

Drawing

4. The wire shall be cold-drawn from rods hot-rolled from billets.

PHYSICAL PROPERTIES AND TESTS

Tension Tests

5. The wire, except as modified hereinafter, shall conform to the following minimum requirements as to tensile properties:

Tensile strength, lb. per sq. inch..... 80 000

Reduction of area, per cent..... 30

6. For wire to be used in the fabrication of mesh a minimum tensile strength of 70 000 lb. per sq. inch shall be permitted.

7. For wire testing over 100 000 lb. per sq. inch tensile strength, the reduction of area shall be not less than 25 per cent.

Bend Tests

8. The test specimens shall withstand being bent cold through 180 deg. without cracking on the outside of the bent portion, as follows:

For wire 0.3 inch in diameter or under, around a pin the diameter of which is equal to the diameter of the specimen.

For wire over 0.3 inch in diameter, around a pin the diameter of which is equal to twice the diameter of the specimen.

Test Specimens

9. Tension and bend test specimens shall be of the full-size section of the wire as drawn.

Number of Tests

10. One tension and one bend test shall be made for each 10 tons or less of each size of wire.

11. If any test specimen shows defects or flaws, it may be discarded and another specimen substituted.

Permissible Variations in Diameter

12. The diameter of the wire shall not vary more than 0.003 inch from the size ordered.

Workmanship and Finish

13. The finished wire shall be free from injurious defects and shall have a workmanlike finish with smooth surface.

Inspection and Rejection

Inspection

14. The Manufacturer shall afford the Inspector, without charge, all reasonable facilities to satisfy him that the wire is being furnished in accordance with this Specification.

15. All tests and inspection shall be made at the place of manufacture prior to shipment, unless otherwise specified, and shall be so conducted as not to interfere unnecessarily with the operation of the works.

Rejection

16. Wire which shows injurious defects subsequent to its acceptance at the Manufacturer's works will be rejected, and the Manufacturer shall be notified.

P.G.

C.E.S.A.

RECOMMENDED SIZES FOR NEW
PRODUCTION
IN

ROUND AND SQUARE REINFORCING BARS

Cross Sectional Area (Square inches)	Size (Inches)
.049	1/4 Round
.110	3/8 Round
.196	1/2 Round
.250	1/2 Square
.307	5/8 Round
.442	3/4 Round
.601	7/8 Round
.785	1 Round
1.000	1 Square
1.266	1 1/8 Square
1.563	1 1/4 Square

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